



Shelton Laundry & Cleaners July 2002 through April 2003 Groundwater Monitoring Results

Abstract

Groundwater samples for volatile organic analysis were collected from eight monitoring wells quarterly from July 2002 through April 2003 at Shelton Laundry and Cleaners in Shelton, Washington. Samples were collected to determine the current concentrations and distribution of tetrachloroethylene (PCE). PCE contamination of the shallow groundwater was discovered in 1997 during an environmental site assessment of a nearby property. The source of the contamination was assumed to be a spill that occurred in 1993 at the dry cleaning facility occupied by Shelton Laundry and Cleaners.

Monitoring of four shallow wells installed in 1998 detected PCE contamination in the well (4W) located where the spill was reported to have occurred, with concentrations ranging from 280 ug/L (July 1998) to 25 ug/L (September 2000). Four additional deeper wells were installed in 2002. Results from the most recent monitoring concur with previous results. PCE was primarily detected in well 4W. PCE concentrations in this well ranged from 9 to 17 ug/L. Trichloroethylene and cis-1,2-dichloroethylene also were detected in 4W, but at concentrations near or below the practical quantitation limit of 1 ug/L. PCE was not detected in any of the four deeper wells.

Although contaminant concentrations have decreased since 1998, PCE concentrations in well 4W exceeded the Model Toxic Control Act cleanup standard of 5.0 ug/L. Because PCE concentrations continue to exceed the cleanup standards in this well, some level of monitoring should continue. Additional investigation or possible remedial action also could be considered to further reduce PCE concentrations at this site.

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Background

Tetrachloroethylene (PCE) contamination of the shallow groundwater was discovered in 1997 during an environmental site assessment/subsurface investigation of a property in Shelton, Washington (Figure 1). PCE was detected at a concentration of 130 ug/L from a temporary shallow boring. The Model Toxic Control Act (MTCA) cleanup level for PCE in groundwater is 5 µg/L.

The Washington State Department of Ecology (Ecology) was notified of the contamination when it received copies of the Environmental Site Assessment Reports in June 1997. Based on these reports, the site was listed on Ecology's Confirmed and Suspected Contaminated Sites List (ISIS List) in December 1997 as Shelton Laundry and Cleaners. Recently the site was ranked based on the Washington Ranking System. Out of a possible score of 5, Shelton Laundry and Cleaners ranked as a 2, with 1 representing the most contaminated sites and 5 the least contamination.

The most likely source of the contamination was identified as the dry cleaning facility occupied by Shelton Laundry and Cleaners which is located adjacent to the property where the site assessment was conducted. The commercial laundry and dry cleaning facility has been in operation since 1935. In 1993, a new dry cleaning machine was installed. As the old cleaning machine was being removed, an unknown quantity of dry cleaning solvent, assumed to be PCE, was reportedly spilled and infiltrated through the broken asphalt in the alley behind the building. This spill event is assumed to be the source of groundwater contamination.

A number of investigations were conducted at the site during 1997 and 1998. During these investigations, several shallow borings were drilled to collect both soil and groundwater samples. In July 1998, four shallow (15 feet deep) monitoring wells were installed to sample the groundwater. Four rounds of groundwater monitoring were conducted at the site between July 1998 and September 2000. PCE contamination was primarily detected in the well located where the spill was reported, with concentrations ranging from 280 ug/L (July 1998) to 25 ug/L (September 2000).

Four additional wells (MW-5 through MW-8) were installed in 2002 to gain a better understanding of contaminant concentrations at deeper depths. In undiluted form, PCE is a dense non-aqueous phase liquid (DNAPL) and has a tendency to sink until it reaches a lower permeable layer in the aquifer. Three of the wells were installed beside three of the existing shallow wells to a depth of 45 feet. The fourth well was installed downgradient of the site to a depth of 60 feet.

Well logs from the deeper monitoring wells indicate that the project area is covered with up to two feet of fill and pavement material, which is underlain by an undetermined thickness of sandy gravel with some sand interbeds. The depth to the water table ranged from about four to six feet over the study period. The sandy gravel in which the wells are screened are part of the Vashon recessional outwash deposits which underlay the western outwash plain between Shelton and the Skokomish Valley to the north. Deeper production well logs near the site indicate that the

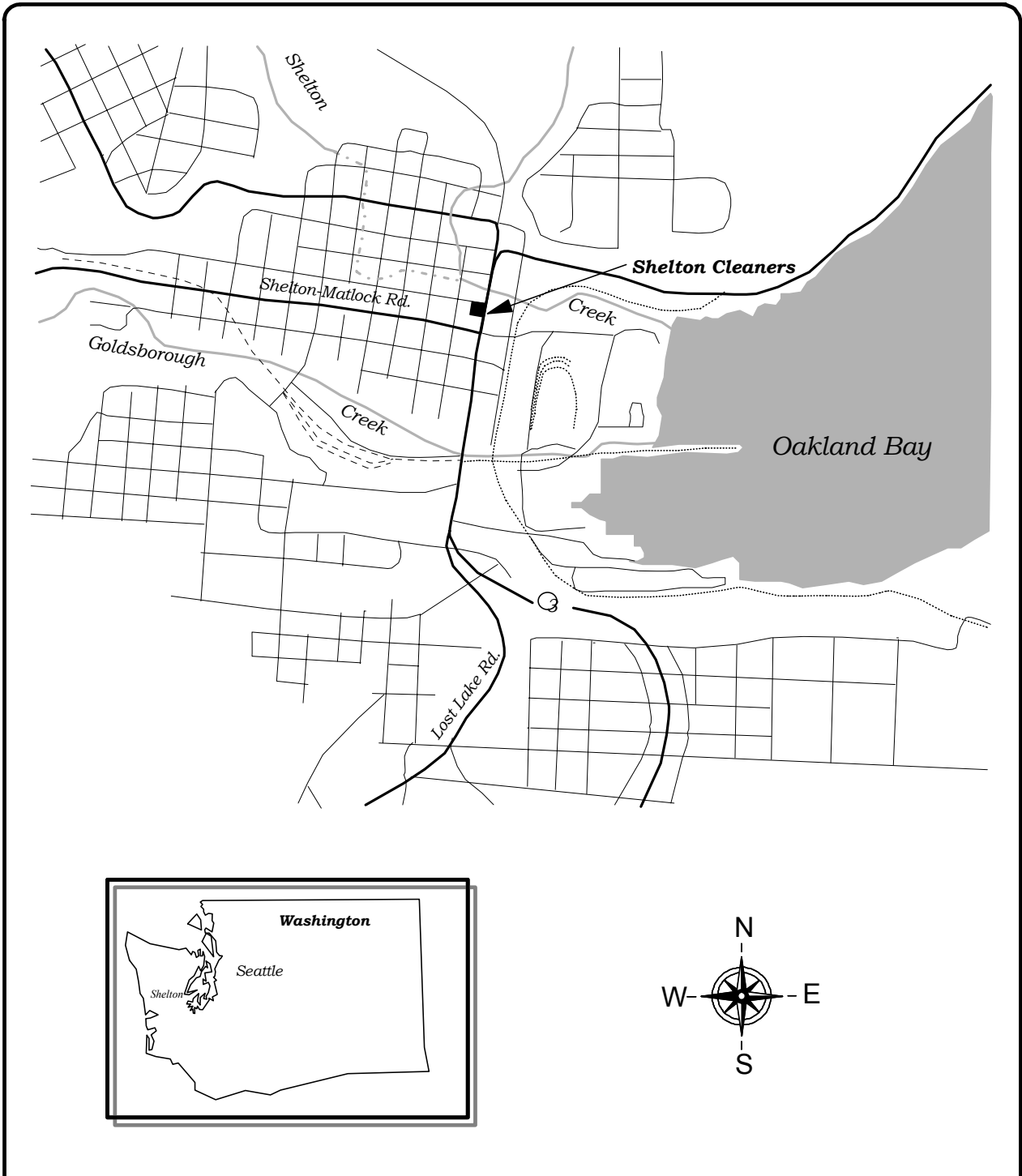


Figure 1: Shelton Laundry & Cleaners Site Location

recessional deposits can attain a thickness of more than 100 feet in the area of Oakland Bay. Regionally, groundwater flow is described as being southward in the loose sand and gravel toward the Shelton Valley and Oakland Bay (Molenaar and Noble, 1970).

Methods

Groundwater Sampling

Groundwater samples for volatile organic analysis (VOAs) were collected from the eight monitoring wells quarterly for one year (July 2002 – April 2003) to determine the current concentrations and distribution of PCE (Figure 2).

The four shallow wells installed in 1998 (1W, 4W, 7W, and 8W) were constructed of 1-inch diameter PVC to a depth of about 15 feet with 10-foot screens. The four deep wells were constructed of 2-inch diameter PVC. Three of the wells (MW-5, MW-6, and MW-7) were completed to a depth of about 45 feet with the screened interval from 35-45 feet below ground surface (bgs). The fourth well (MW-8) was installed to a depth of 60 feet with the screened interval from 50-60 feet bgs.

Static water levels were measured in all wells using a commercial electric probe prior to well purging and sampling. Measurements were recorded to 0.01 feet and are accurate to 0.03 feet. The probe was rinsed with deionized water between measurements. Wells were purged through a flow cell until pH, specific conductance, and temperature readings stabilized. Purge water from all the wells was collected and stored on-site in 55-gallon drums. This waste has been transported and disposed of in accordance with State of Washington regulations (Chapter 173-340-400 WAC).

Monitoring wells MW-5, MW-6, MW-7, and MW-8 (2-inch diameter wells) were purged and sampled using a stainless steel submersible pump, with a pump rate of less than 1-liter/minute. Samples were collected into pre-cleaned vials using the submersible pump. The pump was decontaminated between each well by circulating laboratory grade detergent/water through the pump followed by a clean water rinse, each cycle lasting five minutes.

Because of the small diameter (1-inch), wells 1W, 4W, 7W, and 8W were purged and sampled with a peristaltic pump. Although studies have shown that there can be a loss of volatile analytes in samples collected with suction lift devices such as a peristaltic pump, in some situations the loss may be small if the sample lift is small and a slow pump rate is used in conjunction with less sorptive tubing material (Parker 1994). To minimize the loss of volatile analytes in wells 1W, 4W, 7W, and 8W, dedicated polyethylene tubing was used in each well and pumped at a rate of less than 1-liter/minute. The sample lift was less than six feet. At the completion of purging, the tubing was disconnected from the pump, plugged, and the entire tubing removed from the well. Water collected in the tubing was allowed to drain into the pre-cleaned sample vials.

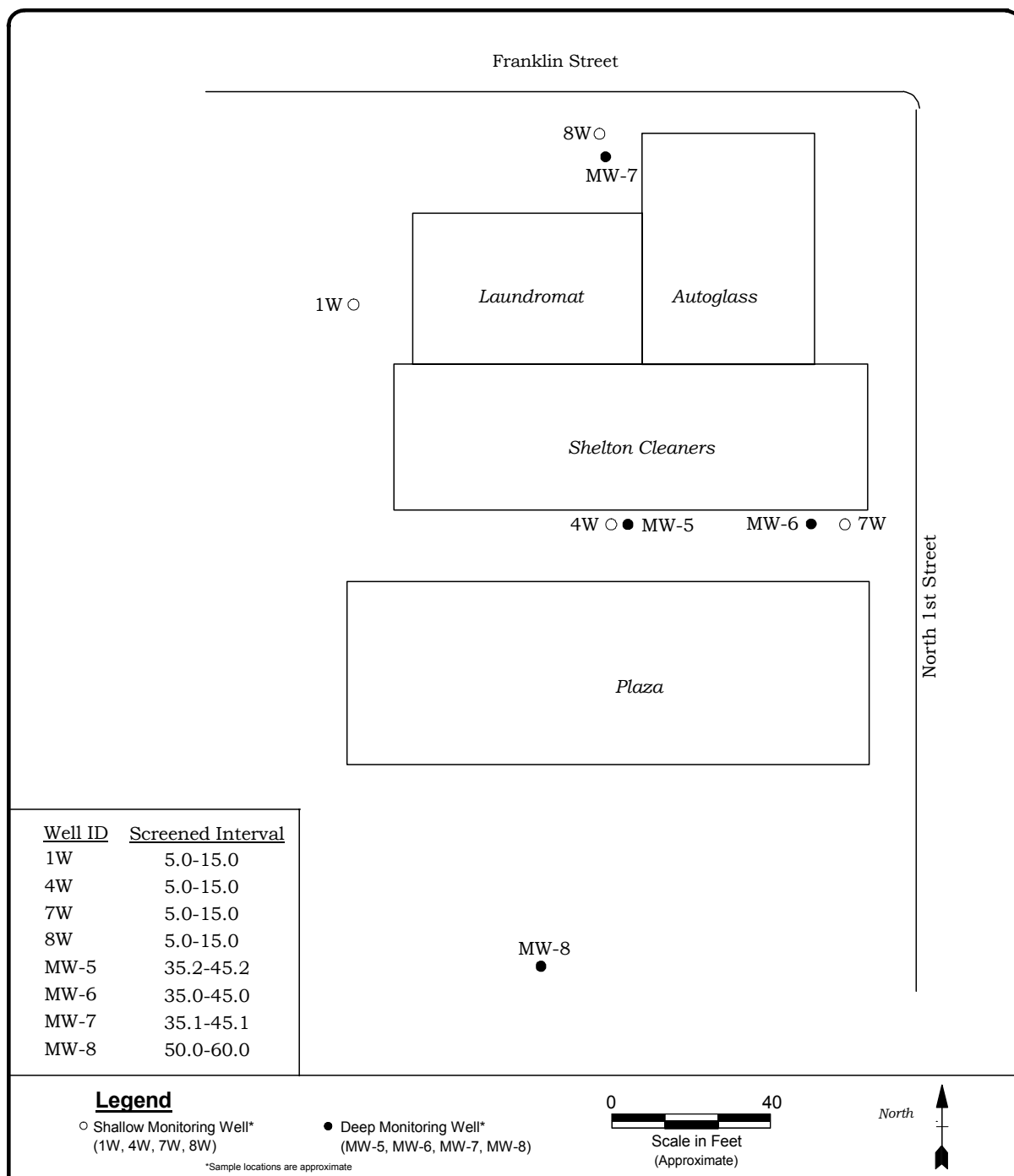


Figure 2: Shelton Laundry & Cleaners Sample Locations

All VOA samples were collected free of headspace in three 40-mL glass vials with Teflon lined septa lids and preserved with 1:1 hydrochloric acid. Upon sample collection and proper labeling, all samples were stored in an ice-filled cooler. Samples were transported to the Ecology headquarters building in Lacey. Samples were kept in the walk-in cooler until picked up by the laboratory courier to Ecology/EPA Manchester Environmental Laboratory in Manchester, Washington. Chain-of-custody procedures were followed according to Manchester Environmental Laboratory protocol (Ecology, 2000).

Analysis

Analytes, analytical methods, and detection limits for both field and laboratory parameters are listed in Table 1. All groundwater samples were analyzed for volatile organics.

Table 1: Analytical Methods for July and October 2002 and January and April 2003 Samples

Analytes	Method	Reference	Detection Limit
<i>Field</i>			
Water Level	Olympic Well Probe	NA	0.01 feet
pH	Orion 25A Field Meter	NA	0.1 Std. Units
Temperature	YSI 3510 Temperature Probe	NA	0.1 C
Specific Conductance	YSI 3520 Conductivity Cell	NA	10 umhos/cm
<i>Laboratory</i>			
VOAs	SW-846 Method 8260	U.S. EPA 1986	1-5 ug/L

In general, the quality of the data is acceptable. Quality control samples collected in the field consisted of blind field duplicate samples, which were obtained from wells MW-5 (July 2002) and 4W (October 2002, January and April 2003). The numeric comparison of duplicate results is expressed as the relative percent difference (RPD). The RPD for PCE ranged from 6% to 8% for the four quarters of sampling. In addition to field quality control samples, duplicate matrix spikes and surrogate compound recoveries were performed in the laboratory. Overall, matrix spikes and surrogate recoveries were within acceptable limits. Quality assurance case narratives and laboratory reporting sheets, with the complete list of volatile organics analyzed, are available upon request from the author.

Results

Field Observations

Total depth of each monitoring well, as well as the range of depth-to-water, temperature, pH, and specific conductance readings, at the time of sampling are listed in Table 2. All field data are presented in Appendix A.

Table 2: Summary of Field Parameters Results for July & October 2002, January & April 2003

Monitoring Well	Total Depth (feet) ¹	Depth to Water (feet) ¹ (range)	Max - Min	Temperature (°C) (range)	Max - Min	pH (standard units) (range)	Mean	Specific Conductance (umhos/cm) (range)	Mean
1W	14.56	4.52-5.35	0.83	9.6-13.9	4.3	6.4-6.9	6.6	216-224	221
4W	13.77	4.41-5.59	1.18	10.1-13.7	3.6	6.9-7.2	7.1	212-223	218
7W	14.83	4.15-5.04	0.89	10.1-12.6	2.5	6.2-7.1	6.6	212-225	220
8W	14.80	4.05-4.78	0.73	9.7-12.3	2.6	6.6-7.1	6.9	215-224	220
MW-5	45.5	4.40-5.26	0.86	10.7-13.4	2.7	6.6-7.4	6.9	210-223	216
MW-6	45.3	4.12-4.88	0.76	10.6-13.0	2.4	6.4-7.2	6.7	214-226	220
MW-7	45.4	3.94-4.66	0.72	10.8-12.3	1.5	6.7-7.0	6.9	160-232	213
MW-8	60.5	4.19-6.20	2.01	10.8-12.5	1.7	6.3-7.6	7.0	210-223	217

¹ Measured from top of PVC casing.

Completion depths for the eight monitoring wells ranged from 13.77 to 60.5 with depth to water ranging from 4.05 to 6.20 feet below the measuring point. Overall, water levels fluctuated less than one foot during the year of monitoring, except for well MW-8 which had a water level change of two feet. Hydrographs showing water-level elevations for each well from May 2002 to April 2003 are shown in Figure 3. The hydrographs show that the seasonal fluctuation is small throughout the year, less than one foot, and the groundwater gradient is relatively flat.

Overall, groundwater flow direction was fairly constant, as determined from water level data collected throughout the monitoring period. Figure 4 shows a typical groundwater flow pattern for the site from water levels measured on January 21, 2003. The location of the water-table contours was determined using a kriging algorithm in the Surfer software program. The groundwater flow direction is approximately perpendicular to the contours. The overall flow direction appears to be southward, which corresponds to the regional flow direction, with flow toward the southwest and southeast. However, with a relatively flat groundwater gradient, changes in groundwater flow direction may occur.

Field parameters were within expected ranges. Groundwater temperatures for the monitoring wells ranged from 9.6 to 13.9°C, with a fluctuation of 1.5 to 4.3°C over the monitoring period. The pH of groundwater in the monitoring wells had an average range of 6.6 to 7.1. Three pH readings were above the normal range during the July 2002 sampling. This has been attributed to a pH probe malfunction. Specific conductance measurements for all of the monitoring wells had a mean range of 213 to 221 umhos/cm.

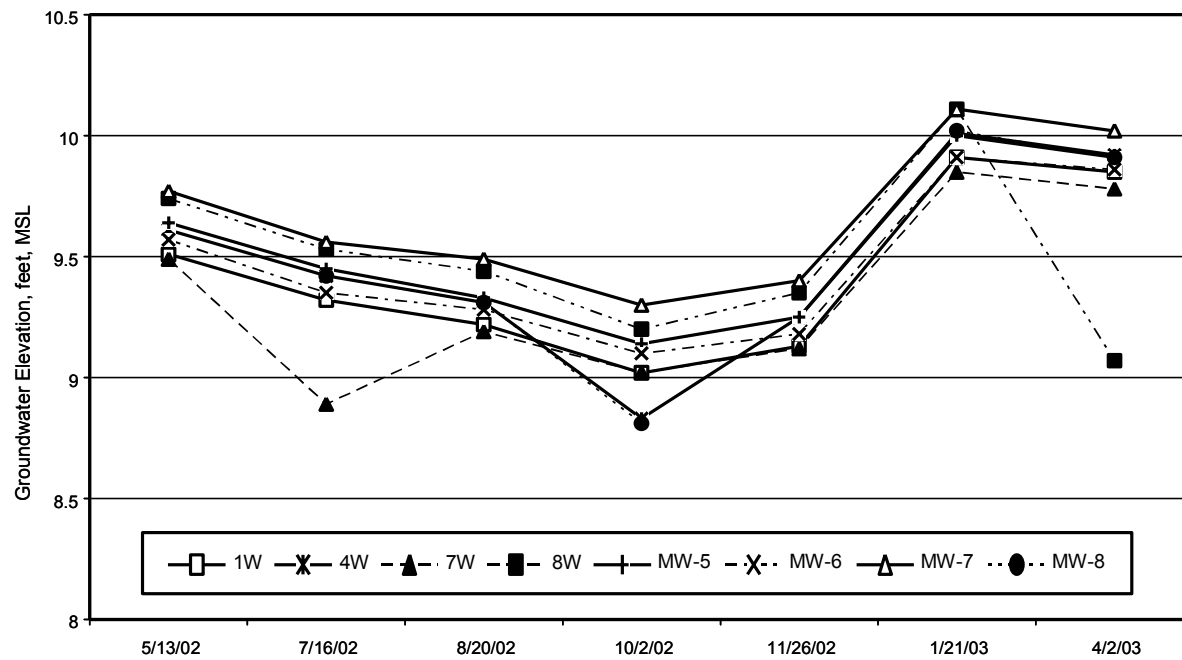


Figure 3: Shelton Laundry and Cleaners - Hydrographs May 2002 to April 2003

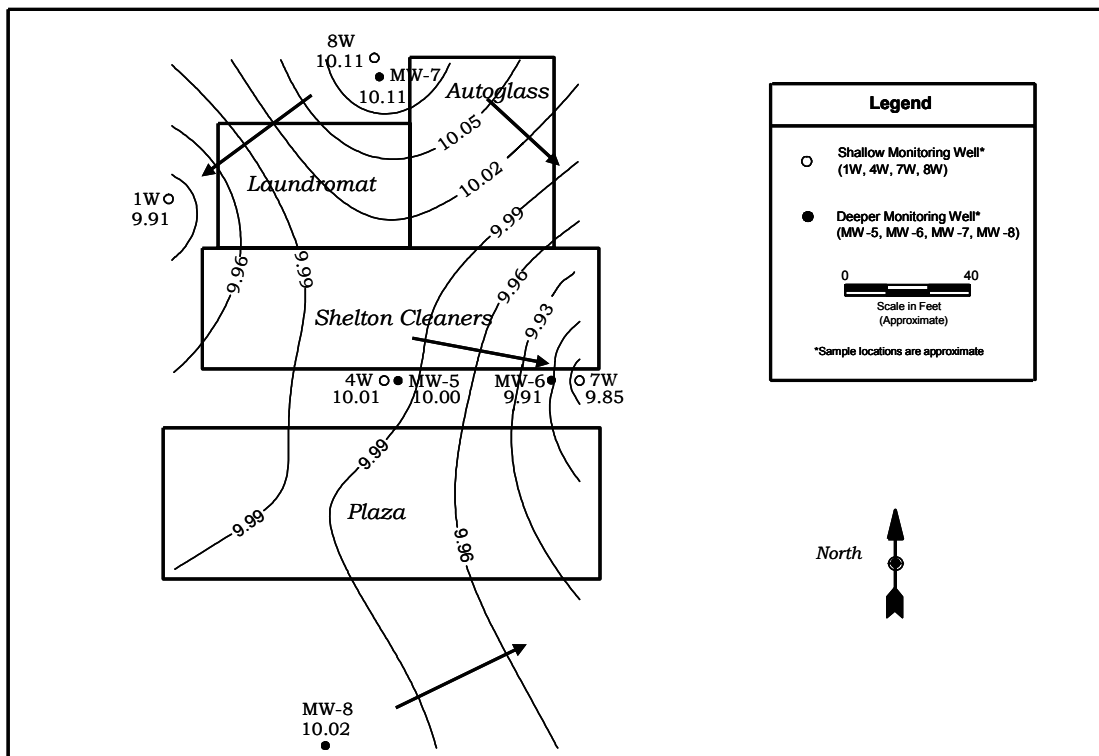


Figure 4: Shelton Laundry and Cleaners - Water Table Elevation January 2003

Analytical Results

Analytical results for volatile organics (VOAs) are summarized in Table 3. For comparison, a summary of historical data for this project is presented in Appendix B.

Table 3: Summary of Analytical Results (ug/L) for July and October 2002, January and April 2003

Well	Tetrachloroethylene				Trichloroethylene				Cis-1,2-Dichloroethylene			
	7/02	10/02	1/03	4/03	7/02	10/02	1/03	4/03	7/02	10/02	1/03	4/03
1W	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
4W	9.3	15	17	12	0.84 J	1.9 J	0.25 J	1.3	0.26 J	0.64 J	0.31 J	0.49 J
7W	1 U	0.19 J	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
8W	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-5	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-6	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-7	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U
MW-8	1 U	1 U	1 U	1 U	1 U	2 U	1 U	1 U	1 U	1 U	1 U	1 U

U : Analyte was not detected at or above the reported value.

J : Analyte was positively identified. The associated numerical result is an estimate.

Tetrachloroethylene (PCE), trichloroethene (TCE) and cis-1,2-dichloroethene (cis-1,2-DCE) were detected in well 4W during all four rounds of sampling. PCE concentrations in this well ranged from 9.3 to 17 ug/L. TCE and DCE were detected in well 4W, but at concentrations near or below the practical quantitation limit of 1 ug/L. In October 2002, PCE was detected in well 7W at an estimated concentration of 0.19 ug/L. Low concentrations of PCE have been detected in this well in the past. No other volatile organics were detected during this sampling.

Discussion and Conclusions

PCE concentrations have decreased since the groundwater contamination was discovered in May 1997. In the initial sampling from a temporary boring in the vicinity of well 4W, the PCE concentration was reported as 130 ppb. Since July 1998, PCE concentrations in well 4W have decreased from a reported 280 ppb to an average of 14 ppb in 2003.

Although contaminant concentrations have decreased since 1998, PCE concentrations detected in well 4W over the past year of monitoring continue to exceed the Model Toxic Control Act (MTCA) cleanup standard of 5.0 ug/L. TCE and DCE, typically associated with the breakdown of PCE, also were detected in well 4W at concentrations below their respective cleanup standards.

It appears that the site continues to be impacted only in the area of well 4W. Because PCE concentrations continue to exceed MTCA cleanup standards in this well, some level of monitoring should continue. Additional investigation or possible remedial action also could be considered to further reduce PCE concentrations at this site.

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Appendix A. Field Parameters

Shelton Laundry & Cleaners: Field Parameter Results for July and October 2002 and January and April 2003

Monitoring Well	Date	Total Depth (feet) ¹	Depth to Water (feet) ²	Temperature (°C)	pH (standard units)	Specific Conductance (umhos/cm)	Purge Volume (gallons)
1W	7/16/02	14.56	5.05	13.9	9.1	224	4
1W	10/2/02		5.35	12.3	6.9	222	8
1W	1/21/03		4.7	9.6	6.6	221	4
1W	4/2/03		4.52	10.1	6.4	216	6
4W	7/17/02	13.77	5.0	13.7	7.1	223	3
4W	10/3/02		5.59	13.7	7.2	218	8
4W	1/22/03		4.41	10.1	7.1	220	4
4W	4/3/03		4.5	10.2	6.9	212	4
7W	7/16/02	14.83	5.04	12.6	10.1	225	5.5
7W	10/2/02		4.91	12.1	7.1	221	10
7W	1/21/03		4.28	10.2	6.2	220	3
7W	4/2/03		4.15	10.1	6.6	212	5
8W	7/16/02	14.80	4.32	12.3	6.9	224	5
8W	10/2/02		4.65	12.1	7.1	218	6
8W	1/21/03		4.05	9.7	6.6	221	7
8W	4/2/03		4.78	10.0	6.8	215	4
MW-5	7/17/02	45.50	4.95	12.7	7.4	223	22
MW-5	10/2/02		5.26	13.4	6.6	214	12
MW-5	1/21/03		4.40	11.3	6.7	217	12
MW-5	4/3/03		4.49	10.7	6.9	210	9
MW-6	7/16/02	45.30	4.63	13.0	8.9	226	12
MW-6	10/2/02		4.88	12.2	7.2	216	21
MW-6	1/21/03		4.27	11.0	6.4	222	10
MW-6	4/2/03		4.12	10.6	6.4	214	11
MW-7	7/16/02	45.4	4.40	11.4	7.0	230	18
MW-7	10/2/02		4.66	12.3	7.0	232	12
MW-7	1/21/03		4.09	11.1	6.7	228	11
MW-7	4/2/03		3.94	10.8	6.8	160	11
MW-8	7/17/02	60.5	5.59	12.0	7.6	216	30
MW-8	10/3/02		6.20	12.5	7.3	223	14
MW-8	1/22/03		4.19	11.4	6.3	219	9
MW-8	4/3/03		5.10	10.8	6.8	210	13

¹ Measured from top of PVC casing.

Appendix B. Historical Data

Shelton Laundry & Cleaners: PCE, TCE, and DCE Results (ug/L) from May 1997 to April 2003

Monitoring Well	Building Analytics	AA Enviro Assessment	GeoEngineers				Ecology			
	5/21/1997	3/3/1998	7/24/1998	11/18/1998	7/12/1999	9/6/2000	7/17/2002	10/3/2002	1/22/2003	4/3/2003
<u>1W</u>										
PCE	--	--	<1.0	<1.0	<1.0	NS	1 U	1 U	1 U	1 U
TCE	--	--	<1.0	<1.0	<1.0	NS	1 U	2 U	1 U	1 U
<u>4W</u>										
PCE	130 ¹	1510 ²	280	130	39	25	9.3	15	17	12
TCE	NR	NR	4.7	<1.0	<1.0	<1.0	0.84 J	1.9 J	0.25 J	1.3
DCE	NR	NR	33	<1.0	<1.0	<1.0	0.26 J	0.64 J	0.31 J	0.49 J
<u>7W</u>										
PCE	--	--	4.3	3	<1.0	1.2	1 U	0.19 J	1 U	1 U
TCE	--	--	<1.0	<1.0	<1.0	<1.0	1 U	2 U	1 U	1 U
DCE	--	--	6.4	<1.0	<1.0	<1.0	1 U	1 U	1 U	1 U
<u>8W</u>										
PCE	--	--	<1.0	<1.0	<1.0	NS	1 U	1 U	1 U	1 U
TCE	--	--	<1.0	<1.0	<1.0	NS	1 U	2 U	1 U	1 U
<u>MW-5</u>										
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U
<u>MW-6</u>										
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U
<u>MW-7</u>										
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U
<u>MW-8</u>										
PCE	--	--	--	--	--	--	1 U	1 U	1 U	1 U
TCE	--	--	--	--	--	--	1 U	2 U	1 U	1 U

PCE = tetrachloroethylene

TCE = trichloroethylene

DCE = 1,2-cis-dichloroethylene

NS = not sampled

NR = not reported

<1.0 = Indicates the analyte was not detected at a concentration above the value shown.

U = The analyte was not detected at or above the reported value.

J = The analyte was positively identified. The associated numerical result is an estimate.

¹ = Concentration reported by Building Analytics is in approximate location of well 4W.

² = Concentration reported by AA Environ Assessment is in approximate location of well 4W.